Proceedings of the Scallop Aquaculture Workshop:Halifax, Nova Scotia, January 24, 2004

L.-A. Davidson and J. Mullen

Department of Fisheries and Oceans
Gulf Region
Oceans and Science Branch
P.O. Box 5030, Moncton, NB
E1C 9B6
Canada

2005

Canadian Technical Report of
Fisheries and Aquatic Sciences 2610

Fisheries and Oceans Pêches et Océans

Canada

Canadian Technical Report of Fisheries and Aquatic Sciences

Technical reports contain scientific and technical information that contributes to existing knowledge but which is not normally appropriate for primary literature. Technical reports are directed primarily toward a worldwide audience and have an international distribution. No restriction is placed on subject matter and the series reflects the broad interests and policies of the Department of Fisheries and Oceans, namely, fisheries and aquatic sciences.

Technical reports may be cited as full publications. The correct citation appears above the abstract of each report. Each report is abstracted in *Aquatic Sciences and Fisheries Abstracts* and indexed in the Department's annual index to scientific and technical publications.

Numbers 1-456 in this series were issued as Technical Reports of the Fisheries Research Board of Canada. Numbers 457-714 were issued as Department of the Environment, Fisheries and Marine Service, Research and Development Directorate Technical Reports. Numbers 715-924 were issued as Department of Fisheries and the Environment, Fisheries and Marine Service Technical Reports. The current series name was changed with report number 925.

Technical reports are produced regionally but are numbered nationally. Requests for individual reports will be filled by the issuing establishment listed on the front cover and title page. Out-of-stock reports will be supplied for a fee by commercial agents.

Rapport technique canadien des sciences halieutiques et aquatiques

Les rapports techniques contiennent des renseignements scientifiques et techniques qui constituent une contribution aux connaissances actuelles, mais qui ne sont pas normalement appropriés pour la publication dans un journal scientifique. Les rapports techniques sont destinés essentiellement à un public international et ils sont distribués à cet échelon. Il n'y a aucune restriction quant au sujet; de fait, la série reflète la vaste gamme des intérêts et des politiques du ministère des Pêches et des Océans, c'est-à-dire les sciences halieutiques et aquatiques.

Les rapports techniques peuvent être cités comme des publications complètes. Le titre exact paraît au-dessus du résumé de chaque rapport. Les rapports techniques sont résumés dans la revue *Résumés des sciences aquatiques et halieutiques*, et ils sont classés dans l'index annuel des publications scientifiques et techniques du Ministère.

Les numéros 1 à 456 de cette série ont été publiés à titre de rapports techniques de l'Office des recherches sur les pêcheries du Canada. Les numéros 457 à 714 sont parus à titre de rapports techniques de la Direction générale de la recherche et du développement, Service des pêches et de la mer, ministère de l'Environnement. Les numéros 715 à 924 ont été publiés à titre de rapports techniques du Service des pêches et de la mer, ministère des Pêches et de l'Environnement. Le nom actuel de la série a été établi lors de la parution du numéro 925.

Les rapports techniques sont produits à l'échelon régional, mais numérotés à l'échelon national. Les demandes de rapports seront satisfaites par l'établissement auteur dont le nom figure sur la couverture et la page du titre. Les rapports épuisés seront fournis contre rétribution par des agents commerciaux.

Canadian Technical Report of
Fisheries and Aquatic Sciences

2005

Proceedings of the Scallop Aquaculture Workshop:Halifax, Nova Scotia, January 24, 2004

Editors

L.-A. Davidson[1] and J. Mullen[2]

[1] Department of Fisheries and Oceans
Gulf Fisheries Centre, Oceans and Science Branch
P.O. Box 5030, Moncton, New Brunswick E1C 9B6

[2] Aquaculture Association of Nova Scotia
The Village at Bayers Road Starlite Gallery
7071 Bayers Road, Suite 320, Halifax, Nova Scotia
B3L 2C2

© Her Majesty the Queen in Right of Canada, 2005.
Cat. No. Fs 97-6/2610E ISSN 0706-6457

Published by:

Department of Fisheries and Oceans Canada
Oceans and Science Branch
Gulf Fisheries Centre
P.O. Box 5030
Moncton, NB
E1C 9B6

This is report MG-03-11-003 for the
Aquaculture Collaborative Research and Development Program (ACRDP)

Correct citation for this publication:

L.-A. Davidson and J. Mullen. 2005. Proceedings of the Scallop Aquaculture Workshop: Halifax, Nova Scotia, January 24, 2004. Can. Tech. Rep. Fish. Aquat. Sci 2610: iv +37p.

106-00577/

Table of Contents

Abstract 1

Résumé 1

Proposal for a Scallop Aquaculture Workshop 2

Scallop Workshop Agenda 3

An Overview of the Scallop Farming Activities of the Groupe Pec-Nord 4
- History 4
- Scallop Culture 4
- Marketing of Cultured Scallops 5

Scallop Farming in St. Pierre et Miquelon, France 6
- History 6
- Production 6
- Culture Site 6
- Scientific Follow-up 6
- Scallop Spat Collection 7
- Other Source of Spat 7
- Intermediate Grow-out 7
- Final Grow-out 7
- Marketing 8
- Research and Development 8

Newfoundland Scallop Farming Experiences 9
- Introduction 9
- Historical Perspective 9
- Seed Procurement 9
- Commercial Scale Culture Technology 10
- Constraints 11
- Conclusions 11
- References 11
- Acknowledgments 11

Great Maritime Scallop Trading Co. 18
- Philosophy 18
- Site Selection 18
- Culturing Experience 18
- Market 19

Sea Perfect Cultivated Products Ltd. 20
- Overview 20
- Grow-out Site 20
- Spat Collection 20
- Gear 20

Operation 21
Market 21
Research 21

Jamieson's Giant Scallops 23
Grow-out Site 23
Gear 23
Personnel 23
Spat Collection 24
Operation 24
Production 25
Marketing 25

Hillsburn Basin Scallop Group Ltd. (1994 to 2000) 26
Public Perception of Aquaculture 26
Marketing 26
Successes 26
Failures 27

REPERE 28
Historical Perspective 28
Evolution of the Fishery in Magdalen Islands 28
Program Implementation 28
R&D Effort Associated with the Program 29
Pilot Project Associated to REPERE 30
Commercial Operation -Pétoncles 2000 30
Financial Structure of Pétoncles 2000 30
Intermediate Culture Equipment Owned by Pétoncles 2000 31
Juvenile Supply for Seeding Purposes 32
Seeding Size and Time 33
Survival, Dispersal and Growth 33
Predation 34
Evaluation of Survival, Dispersion and Growth of Seeded Scallops 34
Main Problems Remaining 34
Conclusion 34

Marketing our Scallops – A Retail Perspective 35
The Retail Advantage 35
Distinguishing the Product 35
Live Scallops 35
Value-Added Product 35
New Trends 35
Areas of Research 36

Recommendation from Participants 37

Abstract

The Aquaculture Association of Nova Scotia (AANS) and the Aquaculture Collaborative Research and Development Program (ACRDP) sponsored a scallop aquaculture workshop which was convened in Halifax, Nova Scotia on January 24, 2004. The association was motivated to organize the workshop due to the upcoming 16th International Pectinid Workshop that will be held in Halifax in 2007. The scallop aquaculture workshop was organized to give the scallop growers in the Maritimes and Gulf Regions an opportunity to meet and exchange information on the scallop aquaculture research and culture techniques presently employed. Knowledge was shared through oral presentations given by three active scallop companies from Nova Scotia and one from Québec (that is affiliated with a Nova Scotia company). The manager of a Nova Scotian scallop firm that folded gave a presentation to explain the successes and failures of the company. Also, guest speakers from the Québec, and Newfoundland and Laborador Regions were invited as well as an international speaker from St. Pierre and Miquelon, France. Scallop marketing information was presented by Université Ste.-Anne - Collège de l'Acadie, N.S. personnel. To wrap up the workshop, participant brainstormed and made recommendations for biological, technical and marketing research priorities that would be beneficial to commercial scallop growers.

Résumé

L'association aquicole de la Nouvelle Écosse, (Aquaculture Association of Nova Scotia (AASN)) et le Programme coopératif de recherche et de développement en aquaculture (PCRDA)ont subventionné un atelier d'aquaculture du pétoncle convoqué à Halifax, Nouvelle-Écosse, le 24 janvier 2004. L'association a été motivée d'organiser cet atelier en raison de l'atelier international, "16th International Pectinid Workshop" qui aura lieu à Halifax en 2007. L'atelier d'aquaculture du pétoncle a été organisé afin de permettre aux aquiculteurs dans les Régions des Maritimes et du Golfe de se rencontrer et d'échanger de l'information concernant la recherche dans le domaine de l'aquaculture du pétoncle et concernant les techniques aquicoles présentement utilisées. Les connaissances ont été partagées par des présentations orales données par trois compagnies actives de la Nouvelle-Écosse et une compagnie du Québec (qui est affilié à une compagnie de la Nouvelle-Écosse). Le gérant d'une compagnie de culture du pétoncle de la Nouvelle-Écosse qui a du fermer ses portes, a fait une présentation pour expliquer les succès et les échecs de la compagnie. Aussi, des conférenciers des Régions du Québec, et de Terre-Neuve et Labrador ont été invités ainsi que un conférencier international de St. Pierre et Miquelon, France. L'information concernant la mise en marché du pétoncle cultivé a été présenté par un invité de l'Université Ste.-Anne - Collège de l'Acadie, N.-É. L'atelier termina avec un remue méninges des participants afin de rédiger des recommandations sur les priorités de recherche sur la biologie, les techniques et la mise en marché, qui seraient utiles aux pectiniculteurs commerciaux.

Proposal for a Scallop Aquaculture Workshop

1. **Workshop title :** Scallop Aquaculture Focus and Research Up-date
2. **Workshop date:** January 24, 2004 / Location: Lord Nelson Hotel Halifax, N.S. in conjunction with the AANS Scotian Pride 2004
3. **Workshop rational / audience targeted / raison d'être**

In 2007, the International Pectinid Workshop will be held in Atlantic Canada, (Halifax, N.S). Due to this upcoming international event, scallop growers in the Maritime and Gulf Regions should take a pro-active step to meet and exchange scallop aquaculture research and harvest techniques presently employed. It is anticipated that this proposed workshop will cultivate increased cooperation and information exchange for existing scallop aquaculture research as well as generate new research. Increased focus and collaboration for existing and new scallop aquaculture related research is essential for the development of this aquaculture sector in Atlantic Canada. Outcomes of this workshop will be presented at the 2007 International Pectinid Workshop. This workshop is also intended to foster recent economic development agreements between France and Canada, particularly St. Pierre and Miquelon and Atlantic Canada.

4. Workshop objectives

The objectives of the workshop are 1) to give the scallop growers an opportunity to meet and exchange ideas and experiences with cultivation in Atlantic Canada, Quebec and France 2) to provide the Atlantic Canadian shellfish aquaculturists with insight from successful scallop aquaculturists from Quebec and the Magdalen Islands 3) to organize a workshop session with industry and researchers aimed as identifying the biological, technical and marketing research priorities for scallop aquaculture in Atlantic Canada.

5. Organizational profile

The Aquaculture Association of Nova Scotia (AANS) was formed in 1977 to support the fledgling fish and shellfish farming industry. In its early days, the Association, which was operated by volunteers, lobbied governments for improved programs for aquaculture, organized meetings and workshops and served as the focal point for technology transfer?

In 1994, the Association and its government supporters decided that the time for professional staff had arrived and hired its first Executive Director. Today Brian Muise is the Executive Director and Jason Mullen is the Research and Development Coordinator. Since 1994, the AANS has played a major role in the development of the aquaculture industry in Nova Scotia.

The Association has spearheaded the creation of industry development strategies; has provided technical services through its field staff; has facilitated communication among members and with outside organizations including government departments/agencies; has liaised with industry in other provinces, countries, and with the research community and the public. The AANS has also taken pro-active steps to develop environmental management guidelines and an environmental monitoring program for its members; has advocated for fair and effective environmental assessment guidelines; has facilitated industry involvement in product quality initiatives and food safety. The AANS provides continual training opportunities for the owners and employees of fish and shellfish farmers in the province. And, Scotian Pride, the annual conference of the AANS has become one of the premiere information-sharing opportunities for industry in the Atlantic Region.

The Aquaculture Association of Nova Scotia is governed by a volunteer Board of Directors; the current President is Glen Brown, Director of Operations for Cooke Aquaculture Inc.

Scallop Workshop Agenda

Sponsored by the Aquaculture Association of Nova Scotia (AANS) and
the Aquaculture Collaborative Research Development Program (ACRDP)

Scotian Pride 2004
January 24th, 2004
Lord Nelson Hotel and Suites
Admiral Room

8:30-8:40 am Welcome & Workshop Overview – Leslie-Anne Davidson
Aquaculture Association of Nova Scotia -Jason Mullen
The 16th International Pectinid Workshop
Aquaculture Collaborative Research and Development Program

8:40- 9:10 Overview of PecNord - Jean Côté

9:10-9:40 Overview Scallop Aquaculture in St. Pierre & Miquelon - Pierre James

9:40-10:10 Newfoundland Scallop Farming Experience - Cyr Couturier

10:35- 10:50 Nutrition Break

Overview of Scallop Farming Experience - Challenges and Successes

10:50 11:10 Great Maritime Scallop Trading Co. - Mike Dadswell
11:10-11:25 Sea Perfect Cultivated Product Ltd. - Ron Boudreau, presented by L.A. Davidson
11:25-11:45 Jamieson's Giant Scallops -Lorne/Wanda Jamieson, presented by L.A. Davidson
11:45-12:05 Hillsburn Basin Group - Blair Cooper

12:05 Lunch - (*provided - Admiral Room)*

1:00-1:30 REPERE II – Georges Cliche, Presented by L.A. Davidson

1:30-2 :00 Marketing Our Scallops Guy Pascal Weiner Université Ste-Anne - Collège de l'Acadie

1:30-3:30 Focus groups*
1) Biological research priorities
2) Technical research priorities
3) Marketing research priorities

*Biological, Technical and Marketing priorities will be set and recorded for the workshop report and disseminated back to the group upon publication

3:30 pm Wrap Up

An Overview of the Scallop Farming Activities of the Groupe Pec-Nord

Jean Côté

History

Pec-Nord Inc. is a scallop aquaculture company that was established in the province of Quebec at the end of the 1980's by its president, Dr. Paul-Aimé Joncas. At first, it was a small aquaculture venture, almost a hobby, but it rapidly grew during the 1990's to become a larger company that acquired knowledge on the sea scallop, its biology and different methods of production in aquaculture. Today, the company employs nine full time, highly competent workers for the various parts of its development, from management to accounting, from scallop production to sales and marketing.

From a sole company producing sea scallop, Pec-Nord inc. evolved and became an integrated group of companies involved in shellfish aquaculture in the eastern part of Canada. Pec-Nord inc. on the Lower North Shore of Quebec, IMAQUA inc. at the Magdalen Islands and Lunenburg Shellfish inc. in Nova Scotia are all parts of the Groupe Pec-Nord. The Group has also established key relationships with other aquaculture companies, as well as scientific relationships with many researchers from different government institutes, universities, etc. This networking is an important part of its success.

The Groupe Pec-Nord is mainly involved in shellfish aquaculture, but also in various activities such as development and sales of shellfish gear and marine biotechnology equipment. The sea scallop, *Placopecten magellanicus*, is the principal shellfish cultured by the Groupe Pec-Nord, but other shellfish such as Bay scallops, American and European oysters, and quahog clams are also produced.

Scallop Culture

Pec-Nord gets its seed supply in two ways. The first approach, used by Pec-Nord inc. and Lunenburg Shellfish inc., is the production of spat in hatchery, followed by a nursery stage under a controlled environment or directly from nature. Up to now, we were able to increase larval survival and growth rate as well as production reliability. Production costs were also reduced and domestication of the species started through genetic selection. Nevertheless, much work is still needed to achieve a highly reliable production from one year to another. The second way to obtain scallop seed is the collection of natural spat, using the typical Japanese method of immersing collector bags in the right place at the right time to catch wild spat. IMAQUA inc. is doing so in the Magdalen Islands.

The grow-out of the spat is usually done in suspension culture. After about a year, spat are harvested from collectors either produced in the hatchery-nursery or placed in the wild. They are then put in pearl nets suspended on submerged longlines at the site. Small scallops are removed from the nets and graded after about another year of culture in these nets. Although this is quite a labour-intensive process, this handling is essential to avoid

excessive fouling on the nets, decreased growth and increased mortality. The grow-out will further continue in various suspended structures until commercial size, that is 50 mm and up. At this time, it's still unclear which structure is the best for final grow-out. Pearl nets, lantern nets, pocket nets, Wang-Joncas cages and oyster tables are all examined. Each one has advantages and problems; the choice will rather depend on the characteristic of the site (ex. depth), the equipment and the method used (mechanized or manual) and also the targeted market (muscle meat only, live in the shell). In some cases, the bottom culture method is also used and small scallops are directly seeded on the bottom within the lease.

Marketing of Cultured Scallops

Once scallops have reached a marketable size, new challenges, questions and costs come up. In 2001, Pec-Nord has started to harvest and sell cultured sea scallops year-round and since then, most of its energy was put on these marketing issues. For scallop sales, there are two possible markets to exploit. The first one is the traditional market, where live larvae, spat or juveniles are sold to other shellfish producers and scientists and muscle meat is sold to restaurants, caterers or fish markets. The second possibility is what we call the "innovative" market, the one that includes live sea scallops, half-shell and roe-on scallops (fresh or frozen), and even the shell itself that could be used for handicrafts or as a mineral source. Pec-Nord is present on both markets but develops mostly the second one by selling live sea scallops.

In the long term, there will be advantages to aim at an innovative market, but it is actually more problematic than profitable to sell live sea scallops. It is hard and costly because you must educate, provide copious amounts of information, attend many shows and develop ways to prepare, cook and taste this product that is unknown to most people. All this work is done for a niche market, thus a very small market. The second major problem is related to the short shelf life of the live sea scallop. It is usually around two to four days, but sometimes it is only a few hours. Further, this short period is often spent in shipping and storing, not in the hands of the end client. Finally, this shelf life varies according to the site of production, the season and the handling methods. All this raises many questions to which there are very few answers right now.

Nevertheless, today the Groupe Pec-Nord invests an important part of its resources in SR&DE, it continues to create various partnerships in Canada and around the world and it develops an expertise in marketing and selling live sea scallops. Pec-Nord believes that even after 40 years of development, the scallop aquaculture is still only at the pilot stage, far behind other animal production. It remains a very risky, unpredictable venture and to succeed and stay into it, one must be a true believer.

Scallop Farming in St. Pierre et Miquelon, France

Pierre James

ARDA (Association de Recherche et de Développement pour l'Aquaculture)

History

Research and Development (R&D) on scallop aquaculture in St.Pierre et Miquelon has been conducted since 1995. Jean-Claude Dao served as the technical expert from 1990 to 2000. In 2001, the "Exploitation des coquilles sarl" (EDC sarl=société à responsabilité limité) was created. Jean-Pierre Carval from the scallop hatchery in Brest, France was the technical expert in 2001-2002 and Benoit Vidal-Giraud (Via-Aqua) has conducted a technical economic feasibility study in 2002.

Production

The EDC aims to collect wild scallop spat (shell height = 300 µm) from collectors set out in September. In the autumn of the following year, when scallops have reached a minimum size of 10 mm they are transferred to intermediate grow-out culture gear. The following summer, when scallops have reached a minimum size of 35 mm, they are transferred to Japanese lantern nets. The scallops are then sorted the following spring when another 10% mortality is expected. The scallops will be marketed when they reach a shell height of 100-105 mm. A meat count of 20 per pound or 10 roe-on meat per pound is expected.

Culture Site

Collection sites, grow-out sites and an intermediate grow-out site are in well defined areas just east of Miquelon. A navigational lane is also identified to assure safe navigation of fishing boats around the culture sites.

Scientific Follow-up

Scientific experiments are being conducted by the "Association de Recherche de Dévelopment pour l'Aquaculture" (ARDA) to gain information concerning the seed quantity, mortality and growth rates and the meat weight shell height relationship of cultured scallops. This information is essential to improve and plan the farming operation and to enhance the commercialization, which can lead to increased profitability.

Scallop Spat Collection

EDC is aiming to capture 400 scallop spat/ collector to minimize competitor species in the collectors, and to maximize the growth rate of the scallop spat in the collector bags. The ideal date and ideal depth for spat collector deployment needs to be determined. Scientific follow-up would include documenting the weekly gonado-somatic index (GSI) of adult scallops and estimating the scallop larval concentration. Experiments to determine potential growth rate increases through husbandry practices such as lifting collector-bags in the water column, must also be conducted.

Other Source of Spat

In the short term, it may be necessary to import scallop spat until the local spat production reaches the required level. The introduction of scallop spat from another area must meet sanitary and health measures that were set by ARDA and IFREMER (Institut Français de Recherche pour l'Exploitation de la MER) and the Canadian Department of Fisheries and Oceans (DFO).

Remote setting experiments may be put in place in the near future and perhaps in the long run, a hatchery could be set-up. Feasibility and cost studies for remote setting and/or hatchery are preliminary to any development of a hatchery.

Intermediate Grow-out

There is a need to maximize the growth rate and minimize the presence of competitors (especially mussels). To achieve this goal, ARDA is investigating the efficiency of spat sorting and reviewing the ideal scallop density in the culture gear as well as the effective mesh size and net type of culture gear which may need to be re-examined in relation to the selected site. Scientific follow-up concerning the above investigation must be conducted to document their impact on growth and mortality of the cultured scallops.

Final Grow-out

At the end of the 2 year final grow-out phase, the cultured scallops will have reached 100-105 mm shell height with a roe-on meat count of 10 per pound or a meat count of 20 per pound. To achieve this goal, EDC must face various management decisions to select sorting dates, scallop densities in culture gear, culture site location(s) and grow-out gear to be employed (cages, lanterns, or ear-hanging). EDC must also decide how to control fouling. Scientific follow-up concerning these husbandry strategies will be conducted to determine their influence on growth and mortality of the cultured scallops.

Marketing

To ensure a high quality healthy cultured product, a water quality surveillance program in the aquaculture zone will be conducted to monitor concentration of chemical contaminants, bacteria of concern and phytotoxins. A health surveillance program will be launched with the French veterinary and agriculture services.

Research and Development

Further research will be required to investigate:

1) Stress limits of scallops being cultured or handled.
2) Scallop spat supply
   Imported spat must be consistently available and require a sanitary surveillance. Remote setting spat experiments are required to determine if the technique is commercially viable.
3) Machinery for sorting and cleaning
   To reduce labour cost and improve yield of the culture project, techniques to sort and clean at a large production scale must be employed. Japanese machinery need to be investigated to determine if they are technically and financially suitable.

Newfoundland Scallop Farming Experiences

Cyr Couturier

Marine Institute of Memorial University

Introduction

The first trials for commercial scallop farming started in the 1960's in Newfoundland in response to declining wild stocks in the inshore areas of the Province. Today, there are 4 licensed commercial scallop farms in Newfoundland and Labrador; however, production has been negligible since 2001 (Figure 1). In fact, commercial-scale Canadian cultured scallop production has been highly variable over the past two decades (Figure 1), and there are a number of constraints to address for a full-fledged industry to develop. Some of these challenges are common to all areas of the country, and are discussed below with a view of providing a synopsis of future areas of endeavour.

Historical Perspective

Table 1 provides a chronological synopsis of the sea scallop culture efforts in Newfoundland. Memorial University was the first to undertake R and D efforts on seed collection and hatchery production during the 1960's and early 1970's. During the1970's, the Department of Fisheries and Oceans Canada led efforts in the development of commercial-scale sea scallop cultivation techniques, focusing in the Placentia Bay area (Figure 2). In the 1980's, Memorial once again undertook most of the efforts to commercialize seed procurement (via hatchery technology) and grow-out (intermediate and final grow-out) (Table 1). Mass mortalities, lack of working capital and seed scallops, and general uncertainty in the industry in the early 2000's has led to a hiatus in the industry.

Seed Procurement

Throughout the 1980's and early 1990's, the main source of scallop spat was the Port-au-Port area (Figure 2) (Details in Couturier et al. 1995). Lack of recruitment at this location for several consecutive years in the early 1990's meant aspiring scallop farmers had to source their seed from either hatchery or other commercial sources. A decision was made by the industry to establish a commercial-scale scallop hatchery in 1995 at Belleoram (Figures 2 and 3) while at the same time sourcing seed scallops opportunistically from Maritime or Québec sources to meet commercial production objectives for individual farms.

In its first year of production, the hatchery produced 30 million 1.5 mm scallops by September but late availability for deployment to field sites resulted in losses of 99%.

The following four years at the hatchery were met with varying success, with some years showing substantial production and others less than 500,000 juveniles.

Considerable research was undertaken to understand all aspects of larval, post-larval and nursery production in the hatchery culminating in several published reports. Efforts were made to focus on reducing costs of production and increasing efficiencies so that the average cost of a 7 mm juvenile scallop from hatchery-nursery trials were in the 1.5 to 2.5 cents per animal range by the time the hatchery ceased operations in 2000, owing to lack of capital and buyers for the seed. One such trial focused on remote set of eyed larvae from the hatchery, which showed that the cost of production for 7 mm juveniles from post-larvae could be reduced as much as 40% under favourable conditions (Figure 4).

Commercial Scale Culture Technology

A variety of intermediate and final grow-out techniques were evaluated at commercial scales during the 1990's including bottom culture, off-bottom culture in racks and tray systems, and various suspended culture methods such as ear-hanging, pearl nets, floating trays or bags (Figure 5). Each scenario was evaluated at commercial scales involving several hundred thousand animals. Efforts were made to minimize the costs of production per scallop by estimating labour components (via time-motion analyses), capital and other expenses and developing various financial models. The findings indicated that the type of growing system employed depended to a large extent on the desired final size to market; labour costs were reduced significantly for intermediate and final grow-out using rack, bags, or tray systems however capital costs varied significantly. Overall, the traditional pearl net met favourably against all other suspended culture techniques, when considering growth, survival, ease of use, capital and labour costs, whereas bottom seeding and ear hanging were not considered viable options for large-scale commercial production (> 1,000,000 animals).

Periodic mass mortalities have occurred at all cultured sea scallop farm sites in Newfoundland and in all areas of Eastern Canada (Couturier et al. 1995). The reasons are variable; however, in many cases there are no obvious explanations for these mortalities. The most likely scenarios are natural environmental perturbations in near-shore rearing areas, which are not fully understood in the context of this stenohaline, oceanic species. There is accumulating evidence that even small variations in salinity or temperature at farm sites may stress the animals and render them susceptible to opportunistic pathogens or to irreversible tissue damage from relatively minor environmental challenges (Nicole Brun, unpublished data). If this is the case, then site selection and handling will be crucial in future developments for this species.

Constraints

A number of constraints have been identified as impeding full commercialization of sea scallop culture in Newfoundland and Labrador. These impediments are associated with large-scale production of 1,000,000 or more animals at a farm site deriving its entire revenue from scallops, and not for small scale (<200,000 scallops) farming scenarios. They include:

1. Lack of consistent, reliable and high quality seed supply, from either hatchery or wild sources.

2. Requires large capital investment, generally in excess of $1 million per commercial farm. Access to such capital is limited given uncertainties in production.

3. Grower and investor confidence is low, given uncertainties in production. Rate of return is marginal at present, for commercial scale production.

4. Market development for value-added products is required.

5. Identification of *suitable* rearing sites and enhanced knowledge of species culture biology is required.

Conclusions

There is a future for scallop farming in Newfoundland and Labrador, provided some of the technical constraints are solved with respect to seed supply, site and biological suitability. The challenge will be to convince investors to take the risk with an alternate, as yet unproven, commercial species of mollusc that does offer some potential for diversification and economic gain.

References

Couturier, C., Dabinett, P. and M. Lanteigne. 1995. Scallop culture in Atlantic Canada, pages 299-340. In: Cold-Water Culture in Atlantic Canada, A. Boghen (ed.), The Can. Inst. for Res. on Regional Develop., Univ. Moncton, Moncton, NB.

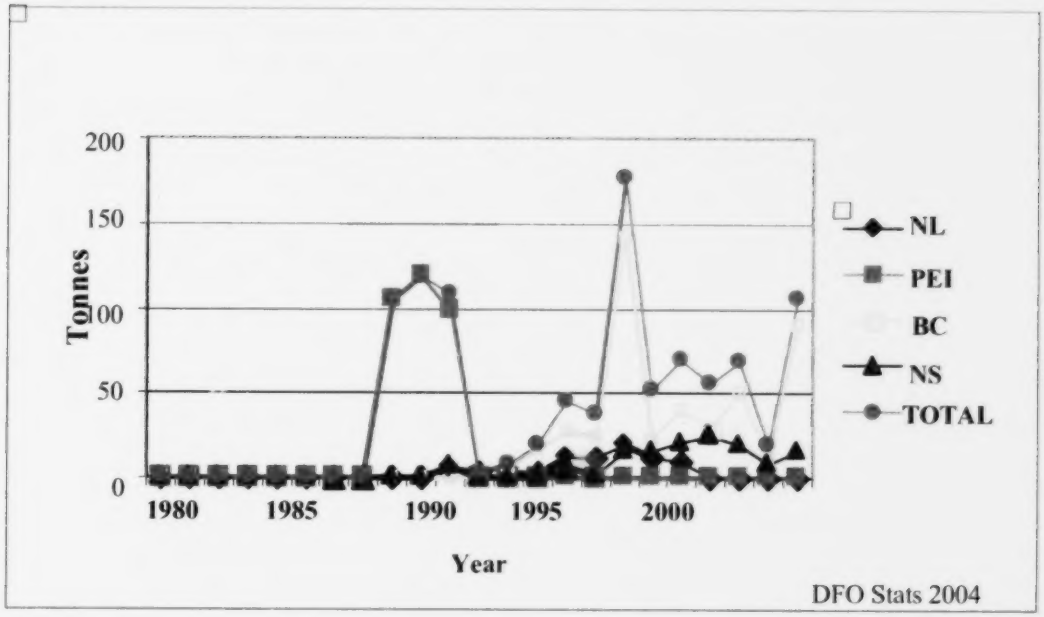
Acknowledgments

We wish to thank all scallop farming pioneers, past and present, for their dedication, effort and willingness to discuss the issues. In particular, the following deserve special mention: Pat Dabinett, Ron Scaplen, Doug and Jennifer Caines, Terry Mills, Mike

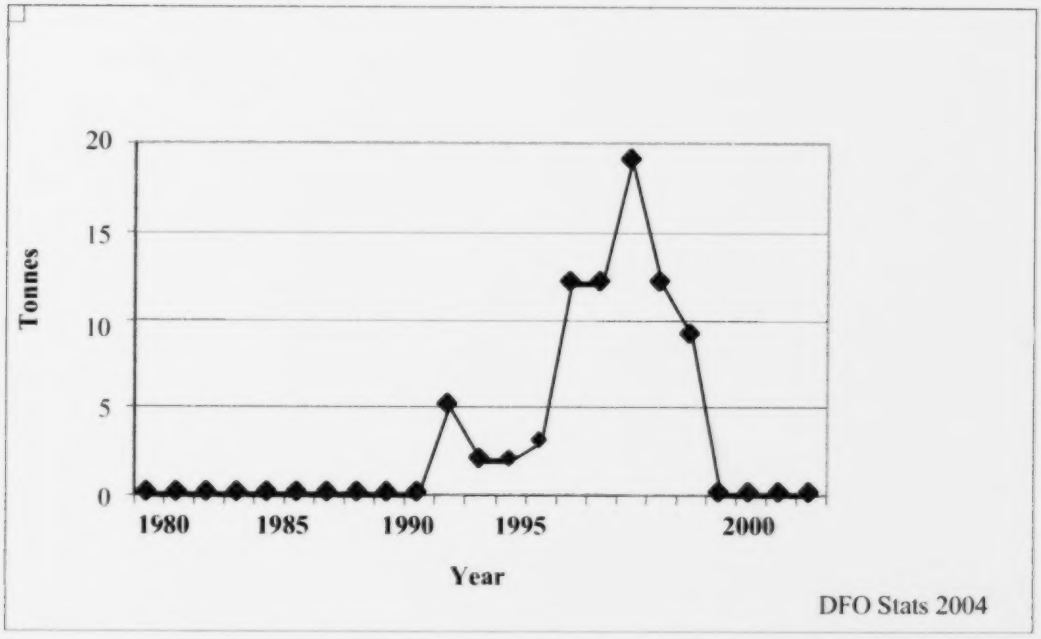
Dadswell, Jay Parsons and our various technicians, colleagues, graduate students who took part in the R and D efforts over the past.

Table 1. Chronological development of commercial sea scallop, *Placopecten magellanicus*, cultivation efforts in Newfoundland and Labrador. From Couturier et al. 1995.

Time Period	**Milestone**
1950's-1960's	Japanese developing bottom and suspended scallop culture following natural stock declines.
Late 1960's	First sea scallop spat collection trials by Memorial University (Scaplen, Evans) around the island of Newfoundland.
Mid 1970's	Larval rearing trials at Memorial University to pediveliger stage (Idler et al.).
Late 1970's	Biological feasibility of cultivating scallops from wild spat collection to market size animals (>100mm) demonstrated in Placentia Bay (Naidu et al.).
1980	First commercial sea scallop farm established in Little Mortier Bay, NL.
1980's	Wild spat collection in Port-au-Port area suggests excellent seed supply
1981-1989	Memorial University "perfects" pilot hatchery production of sea scallops to 5mm shell height (Dabinett et al.).
Late 1980's	Two commercial scallop farms established on south and north coasts.
1992	Patented sea scallop hatchery methodology (Dabinett).
Early 1990's	Spat collection no longer economical in Port-au-Port. Low spat numbers thought to be due to over-exploitation of wild broodstock.
1995-2000	Trials on developing farm best practices and lowering costs of production for grow-out (Parsons, Couturier).
1995	Technical constraints to commercialization outlined and industry R and D project established to address them. Commercial scallop hatchery built in Belleoram.
2000	Belleoram seed hatchery closes doors after 5 years due to variable production and uncertain industry interest.
2000-2001	Sudden, unexplained mass mortalities at two commercial farms (Pools Cove and Charles Arm) in age classes 1-4 years results in 80% or more dead scallops. Industry lacks confidence, and stops production.
2004	4 commercial sea scallop farming licences, but no production.



A



B

Figure 1. (A) Annual production of cultivated scallops in Canada over the past two decades (excluding seabed culture in Québec) and (B) annual production of sea scallops, *Placopecten magellanicus*, in Newfoundland over the past 20 years.

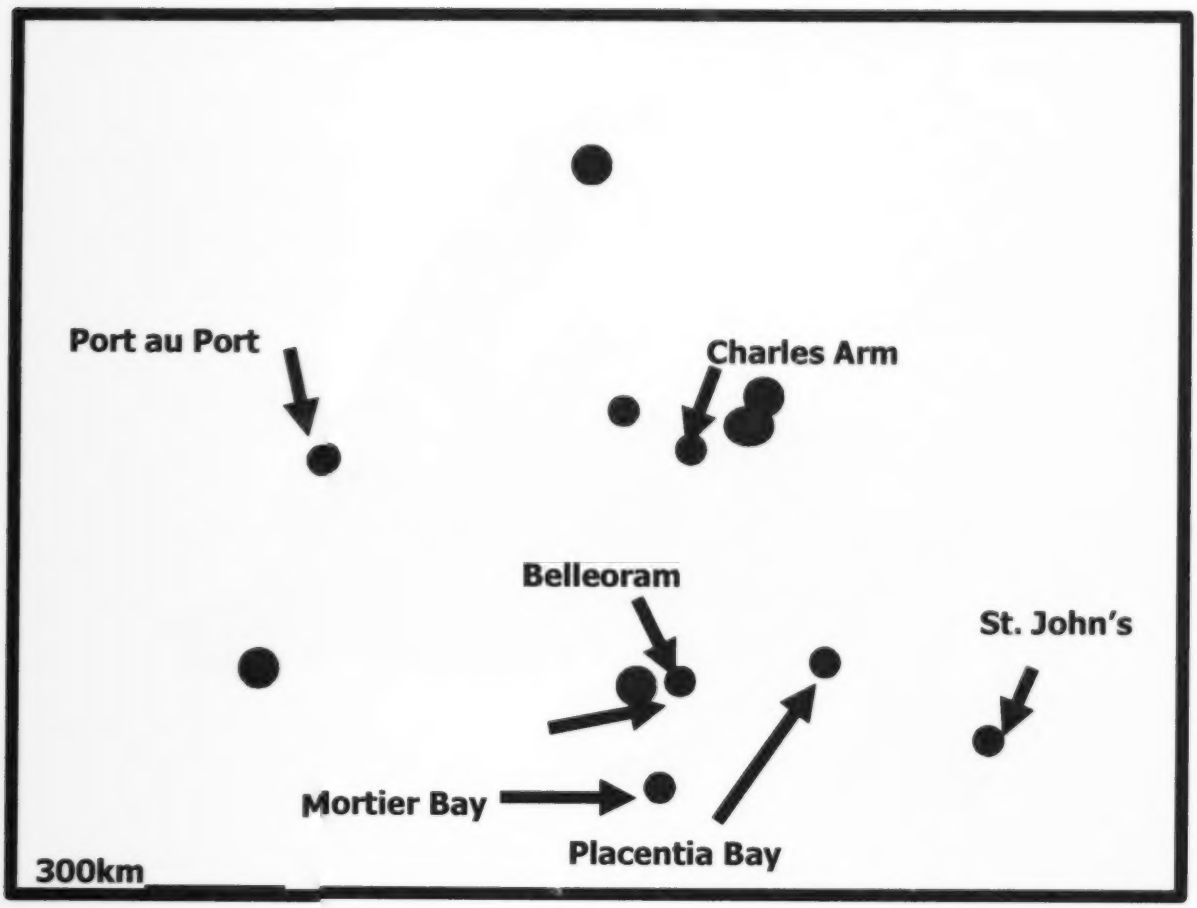


Figure 2. Generalized map showing place names mentioned in the text. Scale is shown in left-hand bottom corner.

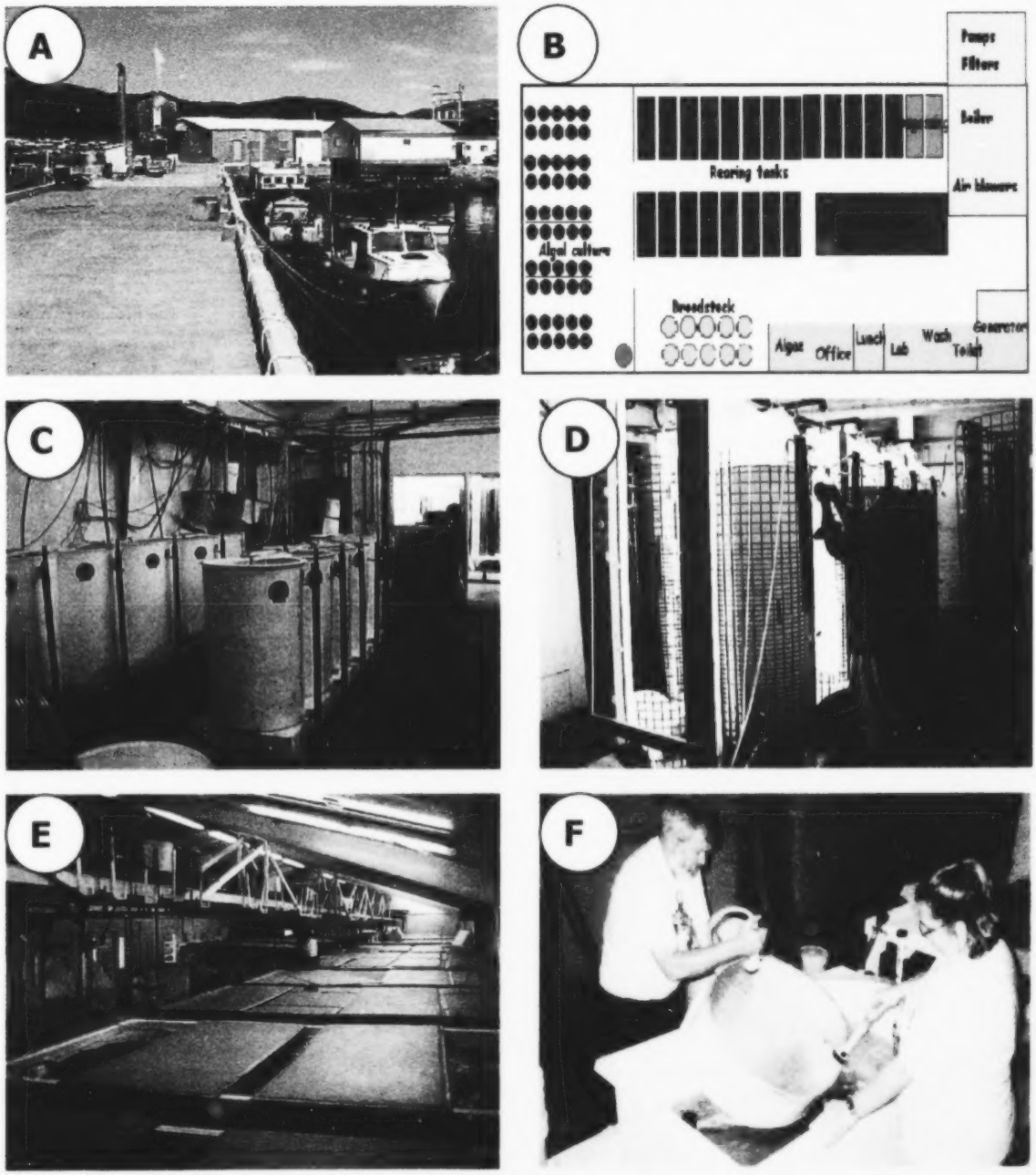


Figure 3. Belleoram scallop hatchery. (A) view of hatchery from public wharf, (B) schematic overview of hatchery layout, (C) broodstock conditioning tanks, (D) continuous algal culture facility, (E) larval and post-larval rearing tanks, (F) washing and grading post-larval downwelling units. All photos courtesy of Dr. Pat Dabinett.

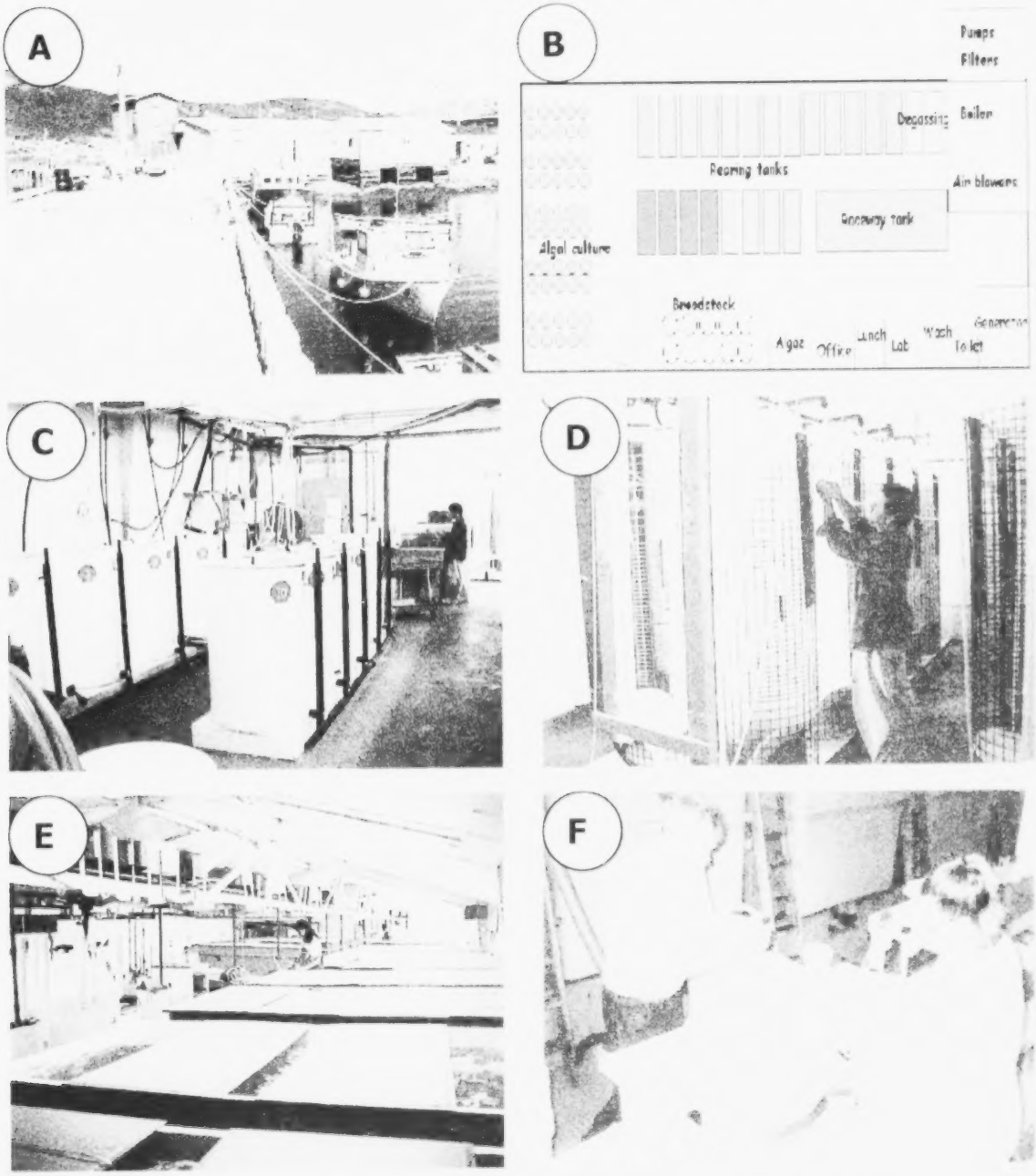
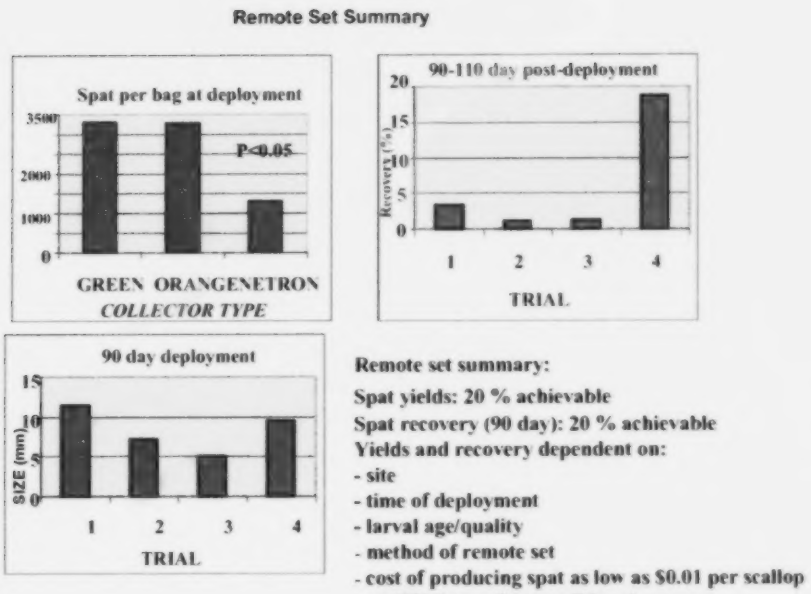


Figure 3. Belleoram scallop hatchery. (A) view of hatchery from public wharf; (B) schematic overview of hatchery layout; (C) broodstock conditioning tanks; (D) continuous algal culture facility; (E) larval and post-larval rearing tanks; (F) washing and grading post-larval downwelling units. All photos courtesy of Dr. Pat Dabinett.



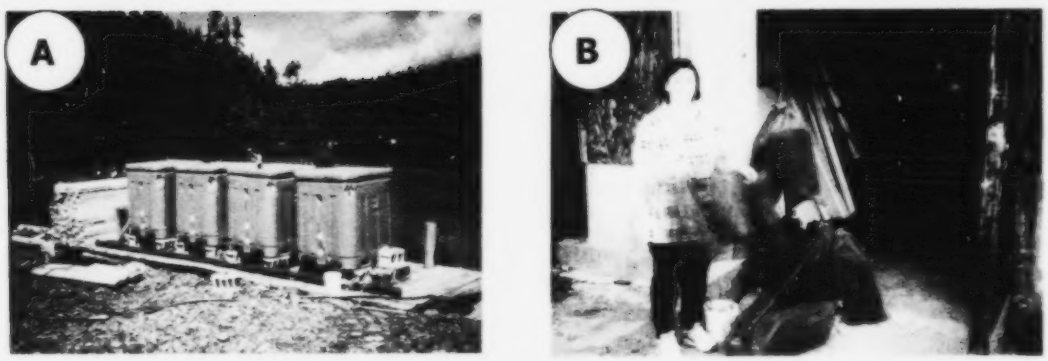


Figure 4. Summary of remote set trials conducted in 1999 with 8.5 million eyed veligers from Belleoram hatchery. (A) remote set tanks near deployment site, (B) remote set substrates.

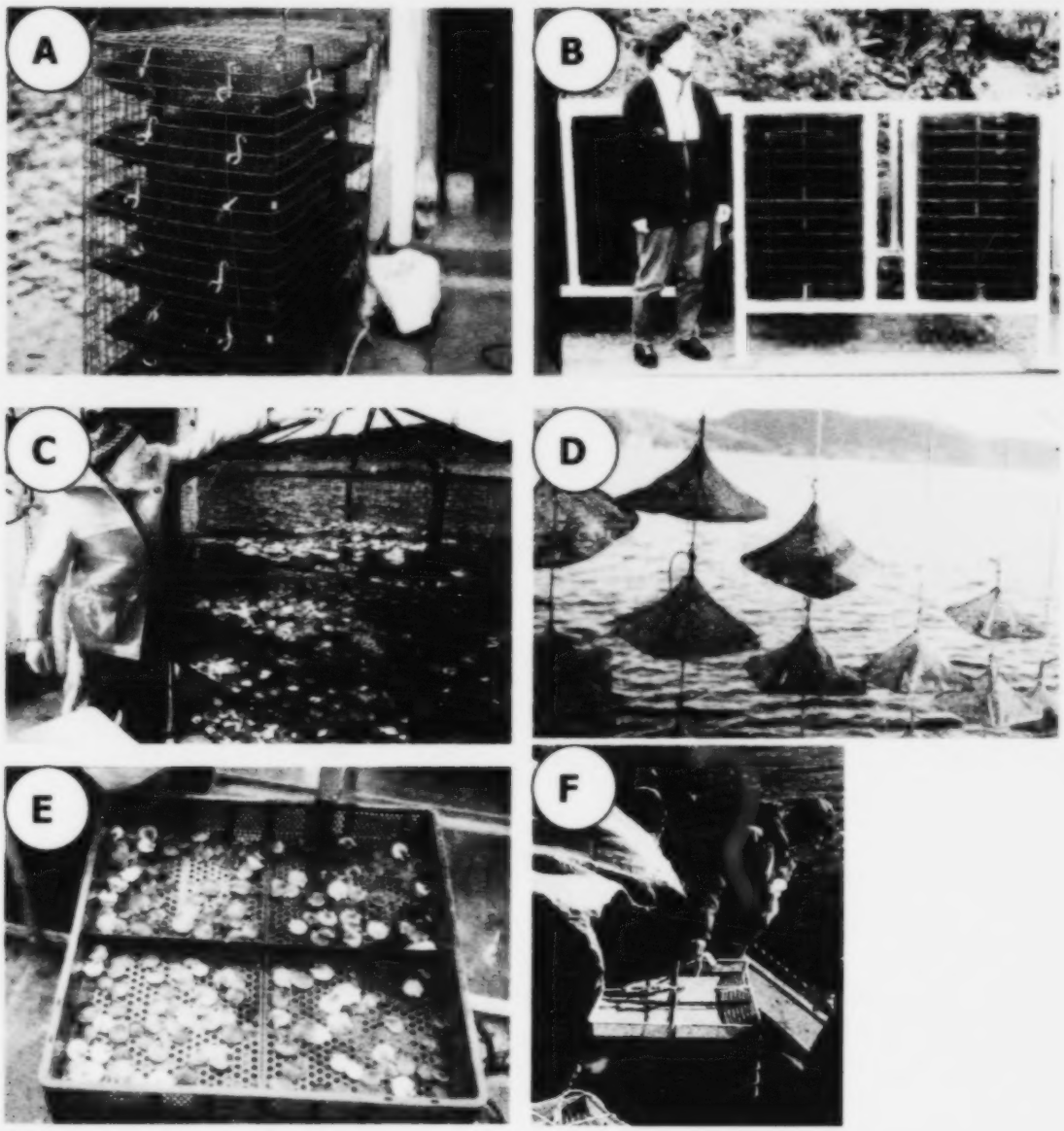


Figure 5. Examples of intermediate and final grow-out scallop gear evaluated for commercial production in Newfoundland. (A) oyster bags, (B) off-bottom rack and tray, Norwegian version, (C) "Savory" tray, (D) pearl nets (10 nets per drop), (E) close-up of Mexican tray, (F) stacked tray system for suspension from subsurface line. Photo credit C. Couturier, except (F) Dr. P. Dabinett.

Great Maritime Scallop Trading Co.

Dr. Mike Dadswell

Philosophy

In the Maritimes or Atlantic Canada, scallop aquaculture can be developed as a family farm. For example, an inshore lobster fisherman who already has a boat would be able to keep his cost and investment low to diversify to scallop aquaculture. We recommended a set-up using a system that is proven, like the Japanese pearl and lantern nets. This equipment is lightweight and can easily be handled by women and even children. The standard protocol for this equipment may have to be adjusted for the giant scallop *(Placopecten magellanicus)*, but it is essentially similar to the methods used for the Japanese scallop (*Patinopecten yessoensis*).

Site Selection

The Great Maritime Scallop Trading Co. selected Mahone Bay to culture scallops because this bay supported commercial scallop beds in the past. In 1888, scallop dragging in North America began in Mahone Bay; however the local stock had collapsed by 1920. The bay has excellent oceanographic parameters for culturing giant scallop. The salinity is stable around 30 ppt and the temperature seldom rises above 18°C. The bay is usually ice-free in winter; however there has been a sheeting of ice during the last two winters. Mahone Bay has no record of extreme or extended shellfish toxicity problems (PSP, DSP, ASP). Monitoring of our farm on a weekly or biweekly basis in summer and monthly in winter for the past 15 years has never found PSP levels above the harvestable limit (80 µ/g). There have only been two closures for DSP (1) and ASP (1), both of which were coast wide blanket closures because of problems at other sites.

The Great Maritime Scallop Trading Co. cultures about ½ million scallops on a 4 hectare (=10 acres = .04 km^2) site with an annual yield of approximately 200,000 market animals. The site has a good culturing capacity because of its depth of 20-30 m, allowing grow-out in 10 floor stacks of either pearl or lantern nets. The farm has been operating commercially since 1991. The farm has excellent growth rates, has not had major ice problems and has not experienced any mass mortality.

Culturing Experience

When culturing scallops, you can expect a 5 to 10 year learning curve. You can design research programs but often the questions to be answered at your site do not arise until you start doing the work. So roll-up your sleeves and get in there.

The Great Maritime Scallop Trading Co. started by bringing scallop spat from Passamaquoddy Bay, New Brunswick. At the time there were few resident, adult scallops in Mahone Bay due to over fishing and spat were not readily available from hatcheries. Since 1996 we have been able to collect scallop spat in large quantities in Mahone Bay, partly because we have learned the correct methods to employ here and partly because the population of wild, adult scallops has increased dramatically. We employ Japanese collectors, filled with old monofilament gillnet and suspended from long lines to depths of 30 m. Average catch/collector at sorting, from depths of 20-30 m, has ranged between 200-1,000 spat over the last 5 years.

In Mahone Bay, scallop spat settle in mid-July and again at the end of September or early October. The spat are left to grow in the collectors for about eight months. After the growth period, when they attain a mean size of 10 mm, the spat are transferred from the collectors to pearl nets at densities of 100 to 200/net. After 2-3 months, at a size of 20-30 mm, they are down stocked to pearl nets at 15-20/net. Finally, the scallops are transferred after a period of 8-10 months and a size of 60-70 mm to lantern nets or onto ear-hanging lines. Presently, the survival rate is about 90-95% since all the transfer work is done on site. In the past, when scallops were brought into a building or kept inshore for any period of time to have them processed, large mortality rates were experienced. *Placopecten* survival is poor if they are handled too much, prevented from continuously feeding, exposed to air for long periods or maintained in dirty water.

Tunicates have made their way to our site but the problem has been kept in check because the gear is never deployed for more than eight months before scallops are transferred and the gear is cleaned. We also try not to put clean equipment in the water during June and July when tunicate settlement is at its peak and we use scuba diving to clean submerged lines.

Market

The Great Maritime Scallop Trading Co. cannot supply all the demands they receive for their cultured scallops. The live, whole market is developing rapidly and it takes about 80% of our production. Scallops have been shipped to Halifax, Toronto, Montreal, New York, San Francisco and Acapulco. Meats are harvested for local restaurants and buyers.

Sea Perfect Cultivated Products Ltd.

Ron Boudreau, Rodney Fougère and Earl Fougère

Overview

Sea Perfect Cultivated Products Ltd. was created in 1998; however members have been involved in scallop aquaculture since 1992. Presently, each member of the company has other income so the farm is a small supplementary operation.

Grow-out Site

The 12 hectares (~=30 acres =0.12 Km^2) grow-out site is located in LeBlanc Harbour, N.S. near Isle Madame. It has a depth of 40 feet (12 m) and in winter it is usually ice free except for the last two winters. Tunicates were a problem only one year when the water temperatures were higher than usual.

Spat Collection

Spat collection is not conducted at the grow-out site because of fouling problems: silt, mussels, seastars and *Hiatella*. It is expensive and time consuming to sort scallops from fouling. Therefore, spat collection is carried out in Chedabucto Bay where collectors remain relatively clean, collecting mostly only scallops (Figure 1).

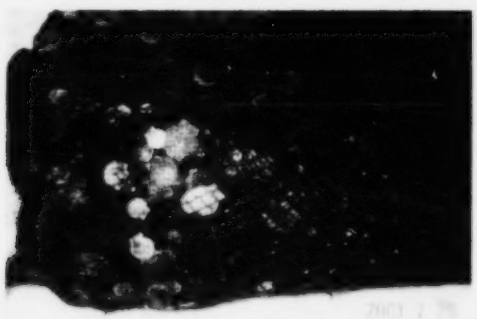


Figure 1. Scallop spat collector from Chedabucto Bay remains relatively clean, collecting mostly only scallop.

Gear

A 45' fishing boat and a 23' aluminium boat are required to conduct the operation. A floating building is located on the site where scallops can be handled. Scallop culture gear includes, spat collectors, pearl nets, lantern nets and Savory cages.

Operation

Approximately 1,400 collectors are deployed every September 25. The following year, the collectors are retrieved in August and moved to the grow-out site. In the autumn, scallop spat are graded for three sizes using screens (20-25 mm, 10-20 mm and 5-10 mm). Larger spat go in 9 mm pearl bags (200/bag) (90% of spat) and smaller spat are placed in 6 mm pearl bags (300/bag). When possible, spat is sold as seed. The remaining spat is over-wintered. The following year, spat are transferred from pearl nets to lantern nets (50/level) or to Savory cages (3000/cage).

Market

When Hillsburn Basin Scallop Group Ltd. was in operation, Sea Perfect Cultivated Products Ltd. was their scallop spat supplier. Presently, various sizes of spat are sold as seed to small scallop farms or for research. When possible, 3-year-old scallops are sold live for the half shell market. Also, scallop meat (1,000 to 2,000 pounds) is sold each year, however, the profitability of this market in questionable.

Research

Sea Perfect Cultivated Products Ltd. participated in a research project entitled "Fencing the Seabed to Protect Scallops from Predation". Funding was received from the Aquaculture Collaborative Research Development Program (ACRDP).

Methodology

The fencing is constructed from 38.1 mm plastic covered mesh wire (same material used in lobster traps) with an overturned edge made from a sheet of galvanised steel (27 gauge). The fencing was embedded about 20 cm into the substrate and stood approximately 1 m above the substrate (Figure 2). To stabilise the fence, anchors, consisting of fish crates filled with cement, were placed at each corner and at midway points on each side. The fenced-in area is 15.24 m X 15.24 m that gives a seabed area of 232.25 m^2 for the scallops.

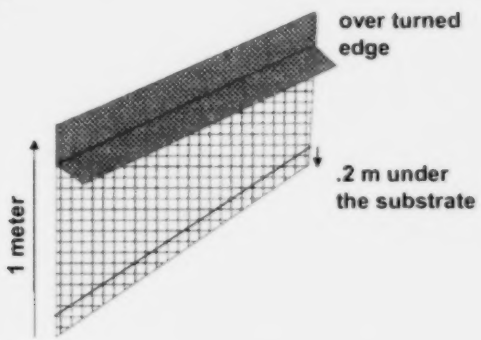


Figure 2. Fence design.

Before seeding the scallops in the fenced-in area, all native animals within the fenced-in area were removed. An estimated 25,000 scallops obtained from the 1999 spat collection were then seeded in this protected area. The seeded density of scallops is estimated to be 107/m^2. Scallops from the same year class were also placed in 2 lantern nets with 10 levels each, one of the traditional culture nets used by Sea Perfect Cultivated Products, at a density of 13 scallops per level. Throughout 2002, divers surveyed the site and removed the predators that were later counted and measured. The site was not visited during the winter. The following spring, the diving surveys were resumed.

Results

At the end of the 2002 sampling season, results looked promising (Figure 3). Most predator species except for moon snails were able to find their way into the enclosed area but were at much lower densities. The following spring, the density of predators was low, however, only a handful of live scallops could be found. Divers observed empty shells in the corners of the enclosed site and noted that the selected bottom was subjected to various strong currents and gyres that may have been detrimental to the scallops.

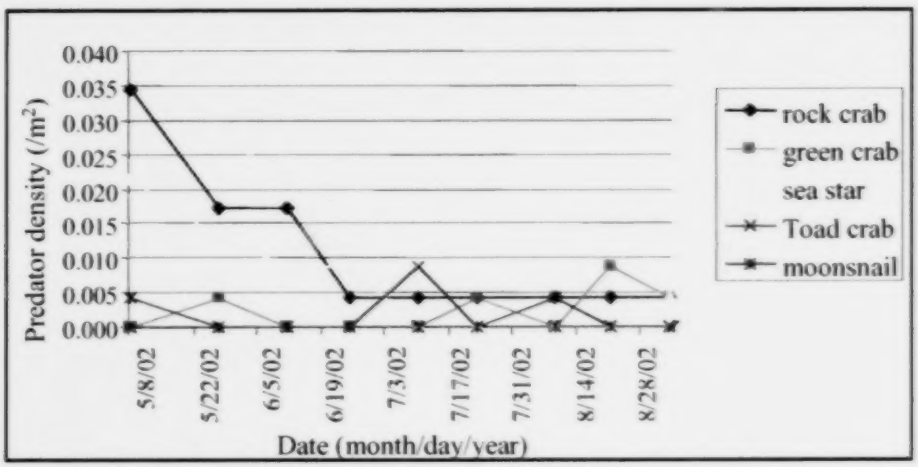


Figure 3. Density of predators (no./m^2) in the fenced-in area.

Conclusion

Sea bed enclosures can protect scallops from predators; however the sea bed selected must provide a suitable environment for scallops. More work is needed to evaluate enclosures as a predator control technique.

Jamieson's Giant Scallops

Lorne and Wanda Jamieson

Grow-out Site

The Jamieson's Giant Scallops farm which is situated in Tor Bay, Nova Scotia started up in the summer of 1995. It took 1½ to 2 years to acquire the 10 hectare lease (~=25 acres =0.1 km^2). During this time, information on growing scallops in other parts of the world was gathered and existing farms were visited: Great Maritime Scallop Trading Co. (Mike Dadswell), Country Harbour Sea Farms and a grower in Arichat, N.S. The lease is also licensed to grow blue mussels since June 15, 1998.

The grow-out site has a water depth of 30 to 40 ft (9 to 12 m), at low tide. From late spring to late autumn the water temperature usually holds between 50 to 59 °F (10 and 15 °C) and rarely reaches above 64 °F (18 °C). In the winter, the grow-out site remains ice free. Tunicate fouling has not been a problem at this site. All the culture gear is suspended 15 ft (4.5 m) below the surface. The grow-out site is accessed from a government wharf that is ~3/4 mile (1.2 km) from site.

Gear

Most of the work is conducted on site on Lorne's 30 ft (9.1 m) lobster boat. Pearl nets are used to grow-out the scallops. Pearl nets are easily handled and the growth of the scallops is reasonably good. The company owns 6,500 to 7,000 pearl nets (3/8 in. (9mm) mesh, however, 600-700 pearl nets has ¼ in. (6mm) mesh). Other essential gear includes ~800 plastic buoys, 32 large cement anchors at 1,500 lbs (680 kg) each and a number of small weights for sinking plastic buoys. Two sets of buoys for marking the perimeter of the site are required (winter and summer). Also, part of the inventory is 200 to 1,000 spat collector bags.

Personnel

The farm is owned and operated by Lorne and Wanda Jamieson. Wanda completed an aquaculture course and developed the business plan for the farm. Lorne is an experienced scallop and lobster fisherman and he finds that having experience in the fishing industry has been a great asset to the learning curve in fish farming. Just being aware of the adverse conditions one can encounter from one day to the next is a challenge. Lorne does most of the work however Wanda helps a fair amount of the time and occasionally help is received from other family members. Summer student are sometimes hired and labourers are often hired during the busiest season (4-6 weeks in the autumn).

Spat Collection

Spat collection is conducted away from the grow-out site. An ideal spat collection site was located where ~1,200 spat/bag is collected with very little clams, mussels or other fouling. One year after the initial collection, the spat obtained at this site have reached the size of a "Loonie" (a one dollar Canadian coin) (~ 1 1/16 in. (28mm)) (Figure 1). Collectors deployed at other locations can collect higher counts of spat per bag, but there is more fouling to clean out therefore it take more time and work. Timing is the key for successful spat collection. The date you deploy the collectors in the water will be a determining factor in how fouled the gear becomes, and on the amount of spat collected and on their survival. Since finding a good collection site, only 200 collectors are deployed annually, however, up to 1,000 collectors were deployed in the past.

Figure 1. Scallop spat from collectors that were in water for approximately one year.

Operation

Each year, scallop spat collectors are deployed on September 15 at the collection site. Two months later they are retrieved and moved to the grow-out site. The following August, the collectors are cleaned and scallops are transferred to pearl nets (~200/net). In October, after the last set of mussels and seastars, scallops are thinned down to 35 scallops per pearl net. One year later, pearl nets are cleaned and thinned down to 15 scallops per pearl net and left to grow for another year. Overall, 20% mortality is estimated.

Production

At peak production, 100,000 to 200,000, 1-year-old scallops were placed in pearl nets yearly. In 2003, the operation was downsized to 20,000 1-year-old scallops in pearl nets. The operation is kept small otherwise it would require more labour. Presently, the farm is a source of supplementary income, but the potential is there to collect and grow out a larger number of scallops. Site capacity is estimated at 300,000 1-year-old scallops per year.

Marketing

To this date, only the meat of the 3-year-old scallops has been sold to several markets: A.C. Coverts, Fisherman's Market and other small businesses. The meat only market is the easiest way to go for this scallop farm. The meat count is 35-40 per pound.

Hillsburn Basin Scallop Group Ltd. (1994 to 2000)

Blair Cooper

Public Perception of Aquaculture

The general public does not hear about aquaculture except in the form of negative media information. The Hillsburn Basin Scallop Group Ltd. met with traditional fishermen and with media to inform them of their culture activities. It is important to promote aquaculture by educating traditional fishermen, recreational water users, landowners, elected officials, and the communities' youth (who will in turn pass on the information to their parents). Work must be done by the aquaculture industry for aquaculture activities to be perceived positively by society.

Marketing

Hillsburn was aiming to be a large commercial farm producing up to 10 million scallops in the water to be marketed each year. The meat only market was deemed not to be financially feasible for Hillsburn due to unit price and direct competition with the traditional wild capture fishery. The live market (scallop with shell height of 50 to 75 mm) could have been profitable; however, there were a number of hurdles. An essential live animal protocol was required by the Canadian Food Inspection Agency (CFIA), assuring that scallops did not contain toxins. This protocol was written and accepted. Live scallops have a limited shelf life, so there are constraints on when and how they may be shipped. The markets are low volume niche markets requiring numerous low volume orders, which increase shipping costs and reduce profitability. Also, knowledgeable brokers to distribute product were not available.

Hillsburn decided to sell their scallops as frozen on the half shell (meat only or meat and roe). Some processing and specialized packaging were required, however, each scallop sold for $0.50 CDN or $0.35 US. Advantage of this product is that it provided a means of differentiating the cultured scallops from the wild ones and it could be stored in cold storage to allow for larger shipping volumes.

Successes

Hillsburn had a well defined site selection R& D program. The general public in the region was not supportive of aquaculture therefore a good public relations program was developed. Hillsburn was able to secure a 100 hectare site (=247 acres = 1 km^2) in the Annapolis Basin. The company owned 500 efficient grow-out cages that had been developed for the high current environment of the culture site. Scallop spat was purchased from Sea Perfect Cultivated Product Ltd. However, the company also successfully developed a remote setting hatchery system for future requirements.

One of Hillsburn's greatest successes is that it was able to develop and market a unique cultured product (Individually Quick Frozen (IQF) scallop on the half shell). The buyer was pre-paying for shipments of this quality product.

Failures

At times, it was difficult to conduct profitable business development because funding agency programs led the company into research initiatives which sometimes conflicted with production. The company did attempt to expand too quickly and the goals and objectives of the company were not well defined.

The major reason that the Hillsburn Basin Scallop Group Ltd. is not in operation today is that the company structure and decision making system were not practical or efficient. At the time of the company's closing, they had 1.5 million scallops in the water and a committed buyer. However, many of the 17 shareholders were no longer interested. Uninterested shareholders would not attend meetings so the required quorum to make decisions was never reached. The legal structure of the company prevented changes from being implemented without a quorum so the company had to be dissolved.

REPERE

Georges Cliche and Madeleine Nadeau
Ministère de l'agriculture, des pêcheries et de l'alimentation du Québec

Historical Perspective

REPERE is a network structure involving two levels of government (provincial and federal), the local scallop fishermen association (21 fishermen) and two scallop processors. In French the acronym REPERE stands for "***RE***cherche sur le ***P***étoncle à des fins d'***É***levage et de ***Re***peuplement" and in English it is "*RE*search on *PE*ctinid *RE*stocking".

Time Frame : 1991-1998

Goal : Develop a profitable technology for the bottom seeding of the giant scallop (*Placopecten magellanicus*) in order to rebuilt the scallop beds of the Magdalen Islands, Québec, Canada.

REPERE II : New program put in place in 1999 involving the same partners plus producers of other regions (Gaspésie and North Shore).

Time Frame : 1999-2004

Goal : 1. Main goal was still to develop a profitable technology for the bottom seeding of the giant scallop (*Placopecten magellanicus*) in Magdalen Islands.

2. An additional goal was to evaluate the potential of suspension culture and bottom seeding in other regions of Québec.

Evolution of the Fishery in Magdalen Islands

Between 1968 and 1993, the scallop landings dropped from a maximum of 300 t of meat to 50 t and the landings stabilized at that level to date. The reduced catches reflected the poor stock status of the scallop population in the Magdalen Islands. The poor stock status is associated with over-fishing. To restore the scallop stock, an aquaculture approach was initiated in 1990.

Program Implementation

Financial feasibility study

- Bottom seeding appears profitable under certain conditions.
- The study was up-dated every year between 1994 and 1997.

- Technological improvements and increased manpower expertise helped to reduce production costs and to define the production scenario for long term projections for financial profitability.

Programming

- Financial feasibility study.
- Juvenile supply for seeding purposes.
- Seeding and harvesting.
- Commercial technology and pilot project.
- Annual transfer of technology meetings.
- Reports

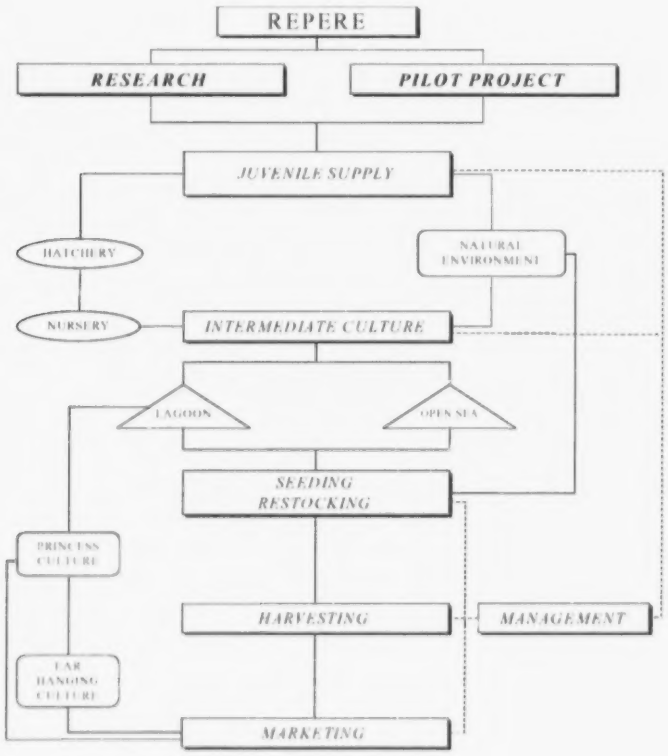


Figure 1. Flow chart summarizing the program and its components

R&D Effort Associated with the Program

- Important program for Research and Development (R&D) has been put in place in 1990 by the provincial and federal governments to characterize biological parameters related to scallop spat collection, intermediate culture, seeding operations and to help find solutions to technical problems.

- Very close association of scientific team and producers has helped to direct R&D towards industry's main problems.
- Annual meetings have permitted the rapid transfer of experimental results to the industry and to identify research priorities.

Pilot Project Associated to REPERE

- In 1992, a pilot project for seeding the bottom was started by the scallop fishers Association to transfer and integrate the «Know – how» obtained at experimental scale.
- The pilot project prevented extensive financial losses related to lack of technical expertise and allowed expertise for large-scale operations to progressively develop.
- Financial support of government was very important during the first five years.
- The pilot project has permitted the fishers to evaluate the potential of seeding operations.

Commercial Operation -Pétoncles 2000

- In 2000, fishers formed a company called, Pétoncles 2000, to commercially seed selected scallop beds.
- 21 of the 23 scallop fishers participate in Pétoncles 2000.
- Pétoncles 2000 owns leases for collection, intermediate culture and seeding of scallops and the company is responsible for managing the fishery on the seeded sites.
- Fishers have accepted an important reduction of their wild fishing sites and the two non-participating fishers cannot dredge on Pétoncles 2000's sites.
- Before opening a site to harvest, Pétoncles 2000 assesses the density of scallop and establishes a global quota.
- In collaboration with fishers, a harvesting plan is established to decide the number of days and hours the fishers are allowed to dredge.
- When the global quota has been reached and catch per unit effort is still high, an additional quota may be allowed.

Financial Structure of Pétoncles 2000

- Pétoncles 2000 is a company owned by the Scallop Fishermen Association (51%) and private investors.
- Pétoncles 2000 conducts the collecting operations, intermediate culture in a lagoon, seeding operations, stock assessment on seeded bottoms, distribution of quotas to scallop fishermen and prepares fishing plans and controls the landings.
- Pétoncles 2000 employs 30 seasonal workers for a period of 4 to 7 months per year.
- Quota of each fisherman is related to his share in the company.
- For each kilogram of scallop meat harvested, fishers have to pay around 30 % of the value of their landings to Pétoncles 2000.

Intermediate Culture Equipment Owned by Pétoncles 2000

- Franken SCS-1TM scallop spat sorter (new system presently tested)
- 300,000 square pearl nets (35 x 35 cm and 4.5 mm mesh size)
- 450 long lines in Havre-aux-Maisons lagoon
- Japanese pearl net and collector washing machine
- 9 meter catamaran for operations in lagoon
- Scallop fishing boat with star wheels for open sea operations (spat collection and seeding operation)

Figure 2. Location of sites associated to REPERE and Pétoncles 2000

Juvenile Supply for Seeding Purposes

- In 1990, results of hatchery-nursery trials in the Magdalen Islands were discouraging.
- On the Lower North Shore, good results were obtained in the commercial size hatchery-nursery operations development.
- In the early 1990's, results of the natural spat collection in Magdalen Islands were encouraging.
- In Magdalen Islands, natural spat collection was chosen as the spat supply for seeding.
- Presently, Pétoncles 2000 deploys 60,000 collectors on two collection sites.

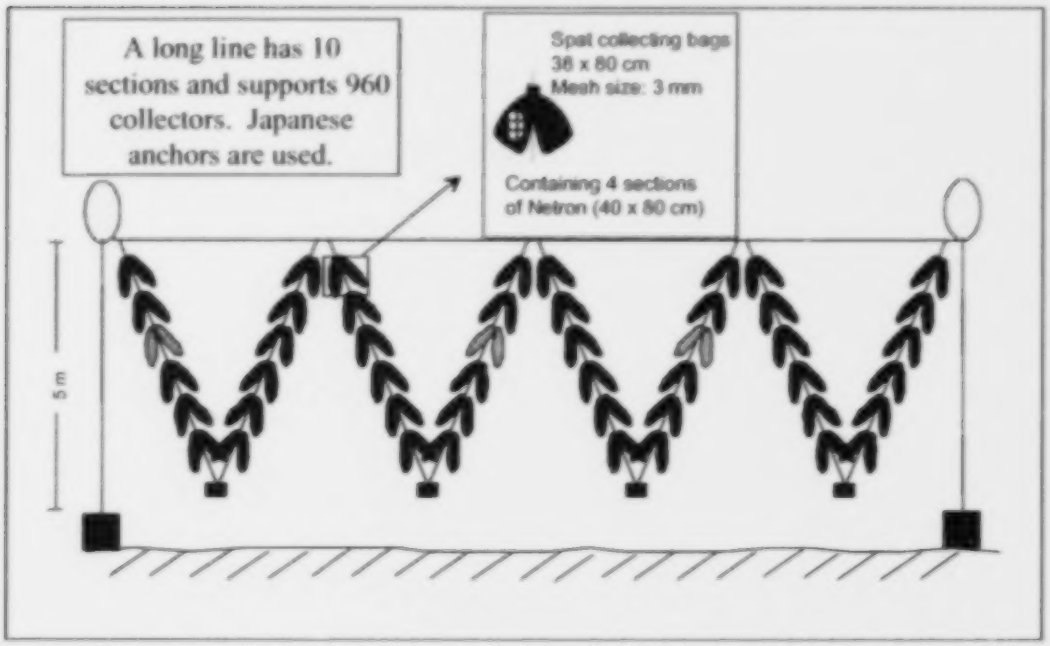

A long line has 10 sections and supports 960 collectors. Japanese anchors are used.
Spat collecting bags
38 x 80 cm
Mesh size: 3 mm
Containing 4 sections of Netron (40 x 80 cm)
5 m

Figure 3. Section of long line with collectors.

Seeding Size and Time

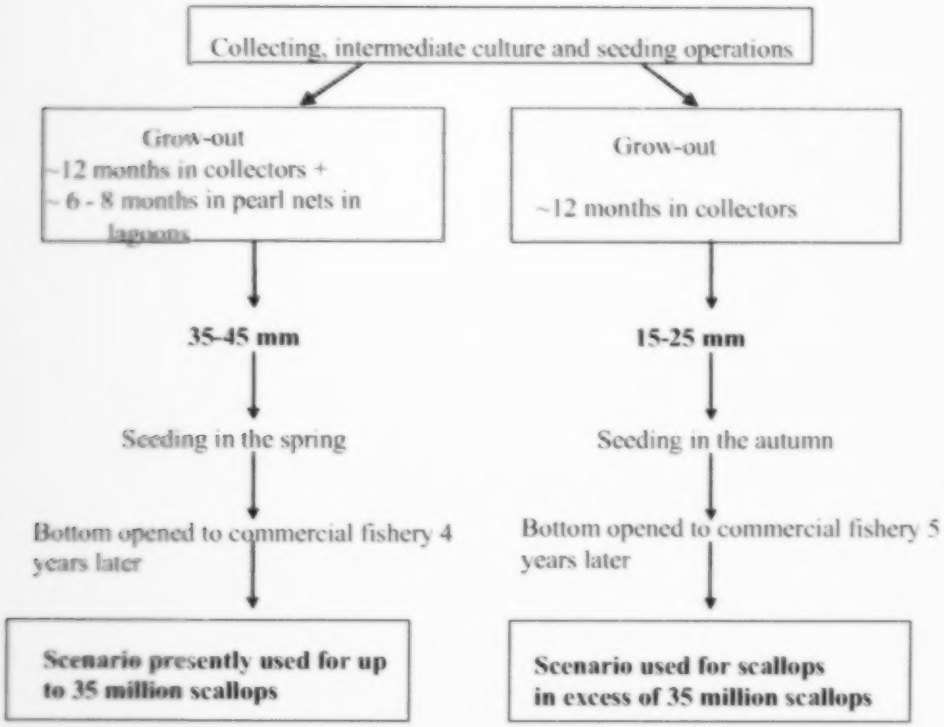

Collecting, intermediate culture and seeding operations
Grow-out
~12 months in collectors +
~ 6 - 8 months in pearl nets in lagoons
Grow-out
~12 months in collectors
35-45 mm
15-25 mm
Seeding in the spring
Seeding in the autumn
Bottom opened to commercial fishery 4 years later
Bottom opened to commercial fishery 5 years later
Scenario presently used for up to 35 million scallops
Scenario used for scallops in excess of 35 million scallops

Figure 4. The two seeding scenarios.

Survival, Dispersal and Growth

- Seeded scallop spat disperse rapidly especially following the autumn seeding(s).
- After a few months, surveys reveal that 25 to 50 % of the seeded scallops are found on the site. However, a survival of 33 to 50 % of seeded spat that remained on the site is observed. For example, the 1996 survey (120 days after seeding) reported that 45 % of seeded scallops were found on the site and of those, 49% survived.
- Scallop growth rate on seeded beds is around 18 mm/year.
- On seeded sites opened to the commercial fishery, harvest rates of seeded scallops are estimated between 10 and 20 %.
- Harvest rates need to be improved to reach 20 to 30 %.

Predation

- Intensive predation on seeded scallops.
- 3 species of starfish: *Asterias vulgaris, Leptasterias polaris* and *Crossaster papposus*.
- 2 species of Crab: *Cancer irroratus* (rock crab) and *Hyas* sp.
- Most voracious predator are starfish.
- Better control of predation is required to improve recovery rates.

Evaluation of Survival, Dispersion and Growth of Seeded Scallops

- A proportion of the seeded scallops are tagged to measure the survival, dispersion and growth of the seeded scallops.
- An under-water camera is used to document scallop and predator abundance.
- An experimental dredge with net liners is also used when assessing abundance of scallops.
- Sea observers are on commercial boats during the harvest of seeded beds.
- One seeded site is open to harvest every year (5 seeded sites and opened in rotation).

Main Problems Remaining

- Recovery rates of scallop spat held for one year in collectors must be improved to increase numbers of scallops seeded (R&D directed to this problem obtained interesting preliminary results).
- Harvest rate of >20% of seeded scallops must be obtained to reach commercial profitability (control of predation is the key factor and R&D projects are presently being conducted to explore solutions).
- Difficulty in finding financing because of the prolonged delay before achieving a return on investment.

Conclusion

- Scallop culture is a new sector of aquaculture and is still fragile because expertises are needed and there are still biological, technical and financial unknowns.
- Financial support of government has been important and is still required to support the industry.
- Important to demonstrate financial profitability to secure current producers and investors and attract new ones.
- Structured R&D is essential to help the industry find solutions to remaining biological and technical problems.

Marketing our Scallops – A Retail Perspective

Guy-Pascal Weiner

The Retail Advantage

It is important to meet the customers and determine their needs and their interests. There may be a marketing opportunity for cultured scallop as a high quality seafood product. Presently, the seafood markets display shellfish for the regular customers. Get acquainted with these customers to promote your product.

Distinguishing the Product

Cultured scallop meats are not readily distinguished from wild scallop meats. However, there are two products currently available that the customer could identify as being cultivated: 1) Frozen scallop meat on the half shell with the roe, and 2) live, whole scallop.

The Peruvian scallop (*Argopecten purpuratus*) is a species of scallop that has a very attractive shell. This attractiveness contributes to it's marketability.

Live Scallops

Unfortunately, there are many problems associated with marketing live scallops. When kept on an ice bed, the meat will have a dry appearance within 2 days. After 3 days, they will gap excessively and the mantle will retract. They must be removed from the display on the fourth day.

Value-Added Product

Consumers willingly pay a higher price for prepared meals. A popular example of a pre-made dish is scallops in a cream sauce topped with grated cheese and circled with a ring of puréed potatoes.

New Trends

Scallop meat can be served raw in Sushi bars.

Areas of Research

- Linking environmental conditions to the shelf life potential of live scallops;
- Improving rearing techniques for the absence of fouling organisms on frozen half shell or live in-shell products;
- A culinary panel to determine taste, texture, appearance of our scallop (*Placopecten magellanicus*) compared to the other species of scallop;
- Design of a holding/display salt water tank for live shellfish;
- Improve shipping methods;
- Identification seals/tags:
  - Confirms product authenticity;
  - Complies with traceability;
  - Inventory control for the producers.
- Product development:
  - Value-added products such as smoked scallops

Recommendation from Participants

At the end of the scallop workshop, participants were asked to suggest biological, technical, and marketing research priorities that would be beneficial to commercial scallop growers.

The following is a summary of the recommendations:

1) Biological Research Priorities
   - Stress responses in post-larval to adult sea scallops
   - Determining causes of mortality/disease issues
   - Physiological tolerance limits/coping with temperature and salinity changes at certain times of the year
   - Influence of environment, genetics, and microbes on scallop performance
   - Managing around phycotoxins
   - Biofouling control mechanisms

2) Technical Research Priorities
   - Development of extended shell-life methods for live, whole scallops
   - Demonstration of reliable, cost-effective seed procurement for commercial scale production
   - Demonstrate financial viability of commercial-scale farming to encourage investors
   - Develop uses for by-products (enzymes, shells, discard tissues)
   - Enhance mechanization to reduce costs of production

3) Marketing Research Priorities
   - Develop value-added products
   - Marketing and promotion of new products

4) Financial Priorities
   - Federal and provincial governments needs to support the scallop aquaculture process by tax write-offs, grants, loans
   - Develop / promote alternate species development funds for scallops and other species
   - Develop sound financial prospectus for commercial farming based on best-practices to encourage investment in the sector

5) Other
   - Translation services for Japanese, Chinese, Norwegian, etc.
   - Electronic database of scallop aquaculture literature especially the grey literature
   - Networking/ more focused workshops
   - Identifying areas of scallop spat collection e.g. Atlantic coast of NS
   - Handbook of recommended procedures for culturing scallop, which would include hatchery and wild spat collection techniques